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needs of men,' *i. e.,* because of its opposition to the abstract reason? One would fain have a system of knowledge that is instrumental in human experience *and* one that is above all vulgar (and sacred) use; but *can* one have both?

The doubt may then be expressed whether Dr. Sterrett's metaphysical assumptions are necessary and sufficient to validate science, epistemology and the other divisions of philosophy, and the arts of life, whether, indeed, they may not be found, when more closely scrutinized, to be in conflict with the genuine motives and meanings of life. One would hardly look for a clear-cut technical statement of a writer's epistemological position in a book of this purpose. But we may venture to doubt whether the ground of certitude there developed could be deemed adequate save on pragmatic assumptions; but if these are admitted, the statement of that ground would of necessity suffer some alteration.

If the book offers the technical philosopher little material and few view-points that are new, yet here much that is not new receives virile, suggestive, stimulating treatment. Its logic is robust, but to a comprehensive survey it does not always appear discriminating and convincing. The author explains, however, in his preface, that his book was 'written in a heat' and that it is both 'semi-technical' and 'semi-popular.'

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Le Darwinisme n'est pas l'Evolutionnisme: RENÉ BERTHELOT. *Bulletin de la Société française de Philosophie,* August, 1905. (Séance of April 6, 1905.—Discussion by MM. Giard, Houssay, Lalande, Pécaut and Rauh omitted in review.)

The proposition that Darwinism and the evolution theory are not identical will be accepted as a truism by any one having even a superficial acquaintance with the literature of philosophical biology; and M. Berthelot might well have spared himself the labor of demonstrating that 'one may conceive of forms of the evolution hypothesis which discard in whole or in part the doctrine of Darwinism.'

Evolutionism and *mechanistic evolutionism* are synonymous for the author, who thereby comprehends any 'theory of the origin of species which does not introduce finality, but which explains facts by their relation to past or present facts, never to future facts.'

According to Berthelot's analysis, "Darwinism consists in the combination of four fundamental ideas: (1) the idea of the struggle for life; (2) the idea of natural selection; (3) the idea of accidental individual variation; (4) the idea of small variation, of slow and continuous change." These propositions may all be contested, he says, without compromising the evolution theory. It need not be pointed out by the reviewer that this analysis, while perhaps true of 'Darwinism' in the narrower sense in which the term is often used, does not fairly represent Darwin's own account of the origin of species.

The doctrine of Lamarck is similarly analyzed into several independent theses: "(1) The formation of new species is a consequence of physicochemical changes produced in the *environment;* (2) there result variations acquired by the organism *during the individual life,* under the influence of external changes and *accumulated by heredity* during many generations; (3) these variations are acquired *in part consciously, in part unconsciously*—consciously in the higher animals, unconsciously in all other living beings. It follows from this that for Lamarck specific variation is collective from its origin, while for Darwin it is primarily individual. And it results that for Lamarck as well as for Darwin specific variation is not abrupt, but gradual."

The idea of 'accidental individual variation' is regarded by the author as a grave defect in the Darwinian theory, and he asks whether 'the changes which are produced in the physicochemical environment, acting at once in the same way on many individuals,' may not 'produce analogous modifications simultaneously among these diverse individuals.'

Many misinterpretations of 'Darwinism' would doubtless be avoided by a timely reference to Darwin's own writings; and in this case it will be instructive to cite, by way of comparison, a few extracts from the 'Origin of Species.' After stating that at first he 'did not appreciate how rarely single variations, whether slight or strongly marked, could be perpetuated,' Darwin proceeds to say: "It should not . . . be overlooked that certain rather strongly marked variations, which no one would rank as mere individual differences, frequently recur owing to similar organization being similarly acted on—of which fact numerous instances could be given with our domestic productions. . . . There can also be little doubt that the tendency to vary in the same manner has often been so strong that all the individuals of the same species have been similarly modified without the aid of any form of selection. Or only a third, fifth or tenth part of the individuals may have been thus affected. . . . In cases of this kind, if the variation were of a beneficial nature, the original form would soon be supplanted by the modified form, through the survival of the fittest."[1] Here both the agency of the *environment* in calling forth variations, and the *collective* character of these (in Berthelot's sense) are distinctly affirmed.

To the principle of 'natura non facit saltum,' which undoubtedly dominated Darwin's ideas of evolution, the author devotes considerable attention. The relevancy of his allusions to the work of de Vries will be readily admitted, for most biologists will probably agree that Darwin greatly underestimated the importance of discontinuous variation.

"The advances of geology," likewise, "have disappointed the hope which the Darwinians founded on them, and seem hard to reconcile with the thesis of small continuous variations." On the contrary, the 'fixity and discontinuity of geological faunas and floras' are supported by recent investigations.

The discontinuity of chemical changes is regarded as furnishing an instructive parallel, for chemical, as opposed to physical, interpretations of vital phenomena are now most in favor. "It is not improbable that what originates a new species resembles rather the synthesis of water or the explosion of a cartridge of dynamite than the progressive heating of a bar of iron." A species exists in a state of stable equilibrium, which can be thrown abruptly into a new state of equilibrium, but not altered gradually. Such metaphors are of course abundant in mutationist literature.

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[1] 'Origin of Species,' 6th ed., pp. 112, 113.

Darwin's bias in favor of the continuity principle is attributed by Berthelot to his historical setting, more immediately to the influence of Lyell. It was one of the fundamental scientific dogmas of his day. "This belief in universal continuity appears to have a double origin: mathematical on the one hand—or, more exactly, physicogeometrical—on the other hand, social." As regards the latter, 'the instincts and prejudices of the triumphant bourgeoisie' gave support to the theory of gradual change as opposed to abrupt or revolutionary change.

After having effected the dissociation of the principal evolution hypotheses of the day, the author proceeds to recombine certain of the elements thus obtained by a twofold act of synthesis. There result two new hypotheses which Berthelot offers under the paradoxical designations, 'Lamarckian Weissmannism' and 'Evolutionistic Cuvierism.'

As regards the first of these he says: "One may hold at the same time, on the one hand, that specific variations are abrupt and congenital; on the other, that these variations are due to changes of the environment, and in consequence that they are from their origin collective, common to many organisms placed in the same environment. For Weissmann all specific variations are congenital, but they are small, purely individual variations, which selection accumulates little by little, and the influence of the environment plays no part in their appearance."

The theories of Weissmann have undergone so many changes in the hands of their author, that one who is not primarily a biologist may perhaps be pardoned for not having followed them through all of their transformations. It is worth while to point out, however, that in his later writings Weissmann distinctly recognizes the influence of *environment* in evoking changes in the germ plasm, and the *cumulative* and *collective* character of the resulting variations. For example, he tells us that the immense number of adaptations of an organism can not be attributed to '*rare, fortuitous variations, occurring only once.* The *necessary variations* from which transformations arise by means of selection *must in all cases be exhibited over and over again by many individuals.*'[2] These variations, we are further told, 'must be due to the direct effect of external influences on the biophors and determinants.'[3] He even goes so far as to concede that 'climatic and other external influences are capable of producing permanent variations in a species,' independently of selection; though he remains convinced that 'the countless majority of modifications' result from selection.[4] "'*The accumulative action of changed conditions of life,*' suggested by Darwin, is consequently theoretically supported to a certain extent by the theory of the continuity of the germ plasm."[5] It is far from the purpose of the reviewer to defend the system of Weissmann, in either its earlier or its later form, but fairness as well as historical accuracy demands this correction.

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[2] 'Germ Plasm,' p. 432.

[3] *Op. cit.*, p. 415.

[4] *Op. cit.*, p. 422.

The second of Berthelot's twin hypotheses rejects 'the belief of Cuvier in providential intervention, in a creative action of the Divinity,' while preserving 'the idea that the origin of species has occurred in the greater number of cases, at least with higher species, in a sudden and collective manner, since it appears difficult otherwise to explain the paleontological facts in which Cuvier found support, and which are not less true to-day than they were eighty years ago.'

We are not told how great a modification Berthelot thinks may be fairly attributed to a single act of mutation; and we are left to wonder whether he would regard any of the larger gaps in the paleontological record as due to the non-occurrence of transitional forms, past or present. Some of the references to geology and to Cuvier would seem to imply this.

Finally, by a supreme act of synthesis, the author proposes to combine the two hypotheses just developed. By this means, 'we should obtain a view of the ensemble of biological evolution which would be neither that of Darwin nor that of Lamarck, since we should abandon the postulate of continuity, which is common to both of them, and since we should attribute the origin of new species neither to selection nor to the inheritance of acquired variations, whatever may be the influence of these two factors to call forth diverse changes, but of less amplitude, among living beings.'

To the reviewer these hypotheses of Berthelot's appear to be logical, rather than biological, creations. One looks through the paper in vain for new facts, and, indeed, for any really original interpretations. This is far from saying, however, that it is entirely lacking in interest or in suggestiveness.

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Les mathématiques et la logique. H. POINCARÉ. *Revue de métaphysique et de morale,* November, 1905. Pp. 815–835.

Sur la relation des mathématiques à la logistique, avec une note de M. Whitehead. B. RUSSELL. *Revue de métaphysique et de morale,* November, 1905. Pp. 906–917.

M. Poincaré, discussing M. Couturat's denial of any appeal to intuition in mathematics,[1] puts the issue with French clearness. Admit that from beginning to end the deductions of mathematics are interrupted by no intuitions: what is the source and meaning of the starting-points, yes, of the whole process? Whenever a new starting-point, a new 'arbitrary convention,' is adopted, why is *it* preferred to others? These conventions would need an accompanying axiom asserting their existence.

[5] *Op. cit.*, p. 437

[1] *Revue de métaphysique et de morale,* 1905, *seriatim.*